Draft new Technical Report ITU-T TR.ISAC-fra

Considerations of integrated sensing and communication in IMT-2020 networks and beyond

Summary

This Technical Report will research the requirements and framework of integrated sensing and communication in IMT-2020 networks and beyond. It will address the following aspects:

– Overview of integrated sensing and communication;

– Potential requirements of integrated sensing and communication;

– Framework considerations of integrated sensing and communication.

Keyword

Integrated sensing and communication, IMT-2020

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1 Scope

This Technical Report aims to research the integrated sensing and communication in IMT-2020 networks and beyond. The scope of this Technical Report includes:

– Overview of integrated sensing and communication.

– Potential requirements of integrated sensing and communication.

– Framework considerations of integrated sensing and communication.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Y.3104] Recommendation ITU-T Y.3104 (2018), *Architecture of the IMT-2020 network*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

[TBD]

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

[TBD]

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

[TBD]

AI Artificial Intelligence

ISAC Integrated Sensing and Communication

KPI Key Performance Indicator

SF Sensing Function

5 Conventions

In this Recommendation:

The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option, and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Recommendation.

6 Overview of integrated sensing and communication

Integrated sensing and communication (ISAC) technology enables the mobile communication network with the capability to sense the physical world. The characteristics of the remote object and the surrounding environment are described by wireless signal, which is regarded as communication-assisted sensing. According to different business scenarios, diverse sensing capabilities involving detection, recognition, speed measurement, ranging, positioning, and imaging can be selected. Through further analysis of the sensing measurement data, the network optimization scheme can be obtained, which is regarded as sensing-assisted communication.

In the context of communication-assisted sensing, data analysis can be used for intelligent node selection, flexible control of sensing processes, and dynamic allocation of sensing resources. For example, according to Key Performance Indicators (KPIs) such as sensing resolution, accuracy, and business requirements, core network functions can be dynamically selected, and resource allocation can be performed as needed. In dynamic network environments, reinforcement learning can enable dynamic decision-making. Moreover, intelligent data analysis and sensing results prediction are required for the reported data from sensing nodes. For instance, deep learning methods can extract high-level features embedded in sensing information to achieve target recognition and classification. When sensing data is insufficient, the network can utilize generative models to generate and enhance data based on historical data, thereby improving network sensing capabilities.

In the context of sensing-assisted communication, in terms of intelligent network optimization, ISAC technology enables real-time network monitoring, user demand analysis, and device status perception. Through data analysis, the network can automatically optimize resource allocation to provide more efficient and stable network connections and service quality, thus meeting the growing communication demands. In terms of adaptive communication, ISAC technology allows the network to dynamically adjust communication parameters based on different environments and usage scenarios.

7 Potential requirements of integrated sensing and communication

Editor's note: generalization of requirement studies avoiding radio-specific studies.

7.1 Common requirements of integrated sensing and communication

[Editor's Note] This subclause will describe the requirements of sensing procedure control capability, request authentication capability, sensing data delivery capability, sensing information processing capability, and sensing results exposure capability.

7.2 Potential requirements of collaborative sensing

[Editor's Note] This subclause will describe requirements of multi-modes collaborative sensing capability, multi-source distributed collaborative sensing capability, and multi-node collaborative sensing capability.

7.3 Potential requirements of communication-assisted sensing

[Editor's Note] This subclause will describe the requirements of sensing node intelligence selection capability, intelligent sensing data analysis and result prediction capability, and sensing data enhancement and augmentation capability.

7.4 Potential requirements of sensing-assisted communication

[Editor's Note] This subclause will describe requirements of intelligent allocation and scheduling of network resources capability, dynamic capability of configuration of network functions , and network intelligent energy saving capability.

8 Framework considerations of integrated sensing and communication

[Editor's Note] This clause will describe framework considerations of integrated sensing and communication.

The figure below and associated text (in italic) is an initial draft for consideration. In fact, among others, it is for consideration the inclusion of a new Network Function (including its formal name) among other possible alternatives and any related reference points aspects.

To provide the capability of integrated sensing and communication, Sensing Function (SF) is introduced as part of the framework defined in [ITU-T Y.3104]. The SF supports sensing authorization, sensing procedure control, sensing node selection, sensing measurement data processing, and sensing results exposure.

The SF interacts with other entities to provide the following sensing services:
Sensing authorization: SF needs to perform authentication or authorization the first time it receives a sensing request.
Sensing procedure control: SF needs to support initiation, update, and termination of the sensing process based on the sensing service requirements when receiving a sensing request from UE or AF.
Sensing node selection: SF needs to consider the location, capabilities, load, and authentication or authorization information of sensing nodes to select the appropriate sensing node for the different sensing services.
Sensing measurement data processing: SF needs to receive the sensing measurement data and uses the data to generate the final sensing results.
Sensing results exposure: SF can expose the sensing measurement data and the sensing results to the sensing service requester/subscriber.

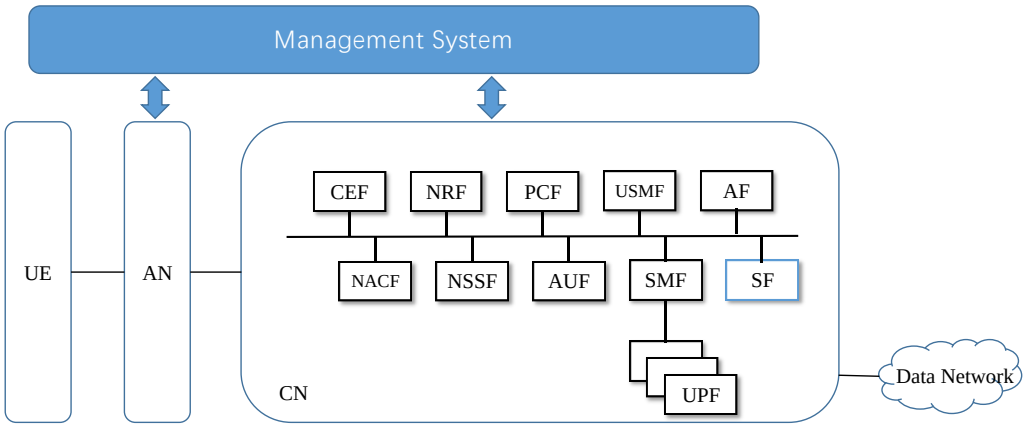

Figure 8-1 Framework of integrated sensing and communication

Figure 8-1 illustrates the framework for adding SF to IMT2020 network for supporting integrated sensing and communication in the future network, which is based on the framework defined in [ITU-T Y.3104].

The core network retrieve sensing information from UE and access network, provides the sensing information possessing capabilities, which is executed by Sensing Function (SF) cooperated with other core network functions. When receives a sensing service request, the core network schedules the sensing process. The core network stores and processes the measurement data reported by the sensing nodes. Subsequently, management system is responsible for the intelligent analysis of sensing data, providing solutions for enhancing both sensing and communication performance. The results are then delivered to third-party applications.

Attachment 1

A.13 justification for proposed draft new Technical Report TR.ISAC-fra"Requirements and framework of integrated sensing and communication in IMT-2020 networks and beyond"

Question:	20/13	**Proposed new ITU-T Technical report**	Geneva, 23 October – 3 November 2023	
Reference and title:	Technical Report ITU-T TR.ISAC-fra "Considerations of integrated sensing and communication in IMT-2020 networks and beyond"			
Base text:	SG13-TD617-R1/WP1		**Timing:**	2025-Q1
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Purpose and Scope (Define what this document will address and its intent or objectives in order to indicate the limits of its applicability):
This Technical Report describes the requirements and framework for the support of the integrated sensing and communication in IMT-2020 networks and beyond. It addresses the following aspects:

-Overview of integrated sensing and communication.

-Potential requirements of integrated sensing and communication.

-Framework considerations of integrated sensing and communication.

Summary (provides a brief overview of the proposal):
Integrated Sensing and Communication (ISAC) technology combines communication and sensing technologies, enhancing communication-assisted sensing performance and sensing-assisted communication performance.

The high integration of information transmission capability and sensing capabilities fosters mutual benefits between communication and sensing, serving as a critical direction and key supporting technology for future networks including IMT-2020 networks and beyond.

Current ISAC projects have involved use cases, service requirements, requirements and capabilities for intelligent transportation, signalling discussion. Therefore, this study will research potential network functional requirements and framework of ISAC, aiming to enhance the IMT-2020 network architecture [ITU-T Y.3104].

This Technical Report will research potential requirements and provide framework considerations for integrated sensing and communication in IMT-2020 networks and beyond.

Relations to ITU-T Recommendations or to other standards (approved or under development)**:**
ITU-T Y.3104

Liaisons with other study groups or with other standards bodies:
ITU-T SG2, SG11, SG20, 3GPP SA1, ITU-R

Supporting members that are committing to contributing actively to the work item:
China Telecom, China Mobile, China Unicom, ZTE Corporation, BUPT

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